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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/912,103	07/23/2001	Huong Thanh Nguyen	5619/DD/LOW K/JW	4476

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APPLIED MATERIALS, INC.
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EXAMINER	
NGUYEN, KHIEM D	
ART UNIT	**PAPER NUMBER**
2823	

DATE MAILED: 08/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/912,103	NGUYEN ET AL.	
	Examiner	Art Unit	
	Khiem D. Nguyen	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 July 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *05/23/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

The non-final rejection as set forth in paper No. (032505) is withdrawn in response to applicants' amendments. A new rejection is made as set forth in this Office Action. Claims (1-24) are pending in the application.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flanner et al. (U.S. Patent 6,410,437) in view of Gabriel et al. (U.S. Patent 6,599,839).

In re claim 1, **Flanner** discloses a method of fabricating a damascene structure, comprising: (a) forming a barrier layer **14** on a substrate **16** having a metal layer **18** thereon; (b) forming a first organosilicate layer **12** on the barrier layer **14**; (c) forming a silicon oxide layer **10** on the first organosilicate layer **12**; (d) forming a second organosilicate layer **8** on the silicon oxide layer **10** (col. 4, line 47 to col. 5, line 50 and FIG. 3); and

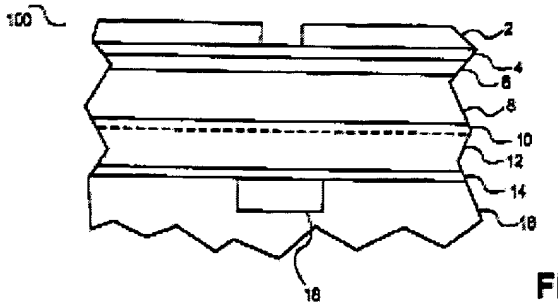

FIG. 3

(e) etching the second organosilicate layer **8** to define vias **20** therein, wherein the second organosilicate layer **8** is etched with a gas mixture comprising a $Ar/N_2/CF_4$, $Ar/N_2/F_6$, and $Ar/N_2/C_9F_8/O_2$ (col. 5, lines 50-64 and FIG. 6).

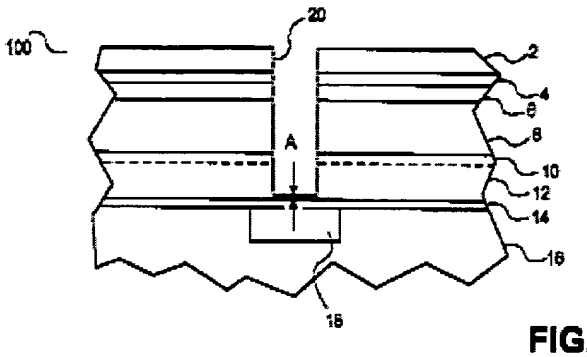

FIG. 6

Flanner discloses etching the second organosilicate layer **8** to define vias **20** therein, wherein the second organosilicate layer **8** is etched with a gas mixture comprising a $Ar/N_2/CF_4$, $Ar/N_2/F_6$, and $Ar/N_2/C_9F_8/O_2$ (col. 5, lines 50-64 and FIG. 6) but does not explicitly teach that the second organosilicate layer is etched with a gas mixture comprising a hydrogen containing fluorocarbon and one or more gasses selected from the group consisting of hydrogen (H_2), nitrogen (N_2), oxygen (O_2), argon (Ar), and Helium (He) as recited in the independent claim 1.

Gabriel, however, discloses that typical etchants for etching an organosilicate glass layer include a hydrogen-containing fluorocarbon (CHF_3) and one or more gases selected from the group consisting of argon (Ar) and oxygen (O_2) (col. 5, lines 58 to col. 6, line 8).

> Typical etchants for etching an organosilicate glass include a fluorinated organic (e.g. C_4F_8, C_5F_8, CHF_3, C_2F_6, CF_4, etc.) together with an inert gas (e.g. argon). Active agents such as oxygen can be added to enhance the etching of carbon contained in the dielectric. The amount of oxygen

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Flanner and Gabriel to enable the process of etching the second organosilicate layer using a gas mixture comprising a hydrogen-containing fluorocarbon and one or more gases selected from the group consisting of Argon (Ar) and Oxygen (O_2) of Flanner to be performed and furthermore to enhance the etching of carbon contained in the dielectric (col. 6, lines 4-8, Gabriel).

In re claim 2, **Flanner** discloses that the method of claim 1, further comprising:

(f) etching the silicon oxide layer **10** to transfer the vias **20** defined in the second organosilicate layer **8** therethrough (FIG. 6);

(g) patterning the second organosilicate layer **8** to define interconnects **40** therethrough, wherein the interconnects **40** are positioned over the vias **20**, and wherein the via pattern is transferred through the first organosilicate layer **12** when the interconnects **40** are defined in the second organosilicate layer **8** (FIG. 14); and

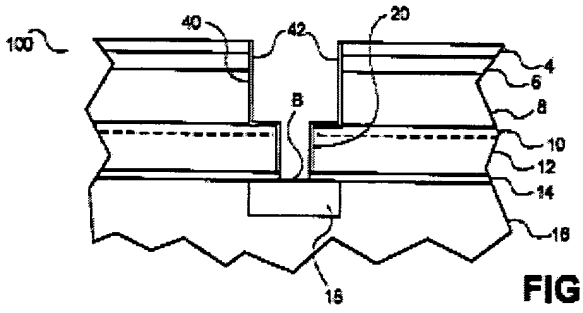

FIG. 14

(g) filling the vias **20** and interconnects **40** with a conductive material (col. 6, lines 60 to col. 7, line 7).

In re claim 3, **Flanner** in combination with **Gabriel** discloses that the interconnects **40** are defined in the second organosilicate layer **8** and the vias **20** are

defined in the first organosilicate layer **12** using a hydrogen-containing fluorocarbon gas mixture (FIG. 12 and related text, Flanner) and (col. 5, lines 58 to col. 6, line 8, Gabriel).

In re claim 4, **FLanner** discloses that the conductive material filling the vias **20** and interconnects **40** is selected from the group of copper (Cu), aluminum (Al), tungsten (W), and combinations thereof (col. 8, lines 22-29).

In re claim 5, **Gabriel** discloses that the gas mixture includes one or more gases selected from the group consisting of trifluoromethane (CHF_3), difluoromethane (CH_2F_2), and fluoromethane (CH_3F) (col. 5, lines 58 to col. 6, line 8).

In re claim 6, **Flanner** discloses that the gas mixture further comprises a gas selected from the group consisting of carbon tetrafluoride (CF_4) and fluoroethane (C_2F_6), and combination thereof (col. 5, lines 50-64).

In re claim 7, **Gabriel** discloses that the gas mixture includes hydrogen (H_2) (col. 5, line 58 to col. 6, line 8).

In re claim 8, **Gabriel** discloses that the second organosilicate layer is etched at a temperature within a range of about -20°C to about 80°C (col. 5, line 58 to col. 6, line 8).

In re claim 9, **Gabriel** discloses that the second organosilicate layer is etch at a pressure within a range of about 20 mtorr (col. 5, lines 58-66).

In re claim 10, **Gabriel** discloses that the method of claim 1, further comprising applying an electric field to the hydrogen-containing fluorocarbon gas mixture (col. 5, lines 58-67).

In re claim 11, **Gabriel** discloses that the electric field is a radio frequency (RF) power (col. 5, lines 58-67).

In re claim 12, **Gabriel** discloses that the RF power is within a range of about 1watt/cm^2 to about 100 watts/cm^2 (col. 5, lines 58-67).

In re claim 13, **Flanner** discloses that the silicon oxide layer **10** is etched with a fluorocarbon gas mixture (col. 5, lines 50-64).

In re claim 14, **Flanner** discloses that the fluorocarbon gas mixture further comprises a gas selected from the group consisting of carbon tetrafluoride (CF_4) and fluoroethane (C_2F_6), and combination thereof (col. 5, lines 50-64).

In re claim 15, **Flanner** discloses that the fluorocarbon gas mixture further includes one or more gases selected from the group consisting of hydrogen (H_2), nitrogen (N_2), oxygen (O_2), argon (Ar), and helium (He) (col. 5, lines 50-64).

In re claim 16, **Flanner** in combination with **Gabriel** discloses that the silicon oxide layer **10** is etched at a temperature within a range of about -20°C to about 80°C (FIG. 6 and related text, Flanner) and (col. 5, line 58 to col. 6, line 8, Gabriel).

In re claim 17, **Flanner** in combination with **Gabriel** discloses that the silicon oxide layer **10** is etch at a pressure within a range of about 20 mTorr (FIG. 6 and related text, Flanner) and (col. 5, line 58 to col. 6, line 8, Gabriel).

In re claim 18, **Gabriel** discloses that the method of claim 1, further comprising applying an electric field to the hydrogen-containing fluorocarbon gas mixture (col. 5, lines 58-67).

In re claim 19, **Gabriel** discloses that the electric field is generated using a radio frequency (RF) power (col. 5, lines 58-67).

In re claim 20, **Gabriel** discloses that the RF power is within a range of about 1 watt/cm^2 to about 100 watts/cm^2 (col. 5, lines 58-67).

In re claim 21, **Flanner** discloses a method of fabricating a damascene structure, comprising: (a) forming a barrier layer **14** on a substrate **16** having a metal layer **18** thereon; (b) forming a first organosilicate layer **12** on the barrier layer **14**; (c) forming a silicon oxide layer **10** on the first organosilicate layer **12**; (d) forming a second organosilicate layer **8** on the silicon oxide layer **10** (col. 4, line 47 to col. 5, line 50 and FIG. 3); and

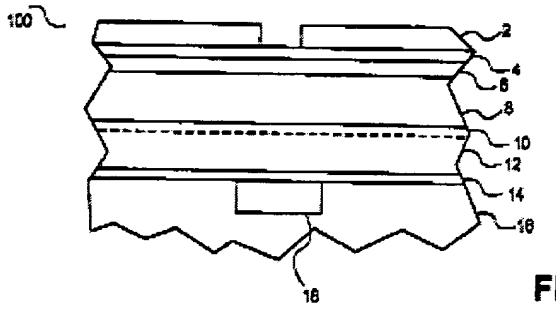

FIG. 3

(e) etching the second organosilicate layer **8** to define vias **20** therein, wherein the second organosilicate layer **8** is etched with a gas mixture comprising a $Ar/N_2/CF_4$, $Ar/N_2/F_6$, and $Ar/N_2/C_9F_8/O_2$ (col. 5, lines 50-64 and FIG. 6).

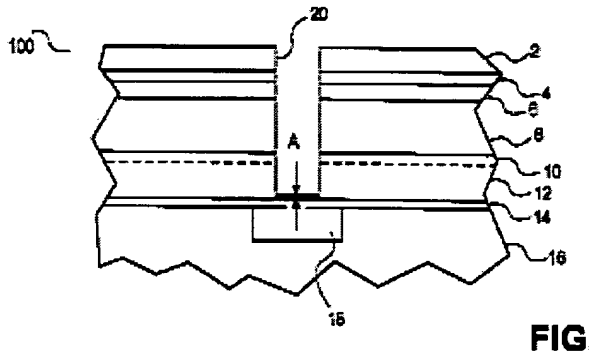

FIG. 6

(f) etching the silicon oxide layer **10** to transfer the vias **20** defined in the second organosilicate layer **8** therethrough (FIG. 6), wherein the silicon oxide **10** is etched with a gas mixture comprising a fluorocarbon gas (col. 5, lines 50-64);

Flanner discloses etching the second organosilicate layer **8** to define vias **20** therein, wherein the second organosilicate layer **8** is etched with a gas mixture comprising a $Ar/N_2/CF_4$, $Ar/N_2/F_6$, and $Ar/N_2/C_9F_8/O_2$ (col. 5, lines 50-64 and FIG. 6) but does not explicitly teach that the second organosilicate layer is etched with a gas mixture comprising a hydrogen-containing fluorocarbon gases and one or more gasses selected from the group consisting of hydrogen (H_2), nitrogen (N_2), oxygen (O_2), argon (Ar), and Helium (He) as recited in the independent claim 1.

Gabriel, however, discloses that typical etchants for etching an organosilicate glass layer include a hydrogen-containing fluorocarbon (CHF_3) and one or more gases selected from the group consisting of argon (Ar) and oxygen (O_2) (col. 5, lines 58 to col. 6, line 8).

> Typical etchants for etching an organosilicate glass include a fluorinated organic (e.g. C_4F_8, C_5F_8, CHF_3, C_2F_6, CF_4, etc.) together with an inert gas (e.g. argon). Active agents such as oxygen can be added to enhance the etching of carbon contained in the dielectric. The amount of oxygen

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Flanner and Gabriel to enable the process of etching the second organosilicate layer using a gas mixture comprising a hydrogen-containing fluorocarbon and one or more gases selected from the group consisting of Argon (Ar) and Oxygen (O_2) of Flanner to be performed and furthermore to enhance the etching of carbon contained in the dielectric (col. 6, lines 4-8, Gabriel).

In re claim 22, **Flanner** in combination with **Gabriel** discloses that the gas mixture for etching the second organosilicate layer comprises hydrogen (H_2) (col. 5, line 58 to col. 6, line 8, Gabriel).

In re claim 23, **Flanner** in combination with **Gabriel** discloses that the gas mixture for etching the second organosilicate layer comprises trifluoromethane (CHF_3), dimethylfluoride, and hydrogen (col. 6, lines 4-8, Gabriel).

In re claim 24, **Flanner** in combination with **Gabriel** discloses that the gas mixture for etching the second organosilicate layer 8 comprises difluoromethane, tetrafluoride, and hydrogen (col. 5, lines 50-64, Flanner) and (col. 5, line 58 to col. 6, line 8, Gabriel).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D. Nguyen whose telephone number is (571) 272-1865. The examiner can normally be reached on Monday-Friday (8:30 AM - 5:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

K.N.
July 31st, 2005

W. DAVID COLEMAN
PRIMARY EXAMINER